Excellence in Compliance Testing

Certification Test Report

FCC ID: VSF24243

FCC Rule Part: 15.249

ACS Report Number: 15-0093.W03.1B

Manufacturer: Juniper Systems, Inc.
Models: FL6501, FL6502

Test Begin Date: March 27, 2015
Test End Date: April 21, 2015

Report Issue Date: June 23, 2015

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Reviewed by:

Kirby Munroe
Director, Wireless Certifications
ACS, Inc.

This report contains 15 pages

TABLE OF CONTENTS

1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations for Certification.

1.2 Product description

The FL6501 and FL6502 are ultra-rugged, handheld computers, integrating transceivers for TouchRead and RadioRead capabilities for utility meter reading work. The FL6501 supports the use of the LPL (Low Power Link) for TouchRead capability, and the FL6502 supports the use of the LPL and RIU (Radio Interrogate Unit) for TouchRead and RadioRead capabilities. The RIU is exempt under FCC Part 101 and depopulated in the FL6501.

The LPL radio operates within the frequency range 903.8 – 912.71 MHz. The RIU radio operates at 956 MHz. The handheld integrates several features such as Bluetooth/802.11b/g/n (FCC ID: VSF23545), cellular radio (FCC ID: VSF23795), GNSS (optional), camera (optional), and barcode scanner (optional).

All radios can transmit simultaneously therefore the FL6501 and FL6502 hosts have been evaluated for radiated inter-modulation products for all combinations of simultaneous transmission and found to be in compliance.

Technical Information:

Detail	Description
Frequency Range	903.08 MHz – 912.71 MHz
Number of Channels	10
Modulation Format	FSK +/-60KHz Deviation
Operating Voltage	3.65VDC (Internal Battery)
Antenna Type / Gain	Inverted F; -12dBi gain

Manufacturer Information:
Juniper Systems, Inc.
1132 W 1700 N
Logan, UT 84321

EUT Serial Numbers: AG2B274

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

Preliminary measurements were collected for the EUT set in three orthogonal orientations. The measurements reported herein correspond to the worst case orientation with respect to the emission limit.

The EUT operates from internal batteries but can utilize an external power supply for battery charging therefore AC power conducted emissions measurements were performed.

Software power setting during test: 0dBm
Software version number during test: Windows Embedded Handheld 6.5 Professional CE OS 5.2.29170 (Build 29170.5.3.12.21) Juniper Version: 1.5.1 WWE
Software version installed on support PC to exercise EUT: RIUapp08 version 0.8.1

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program (NVLAP), Lab Code 200612-0. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number: 511277
Industry Canada Lab Code: IC 4175A
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

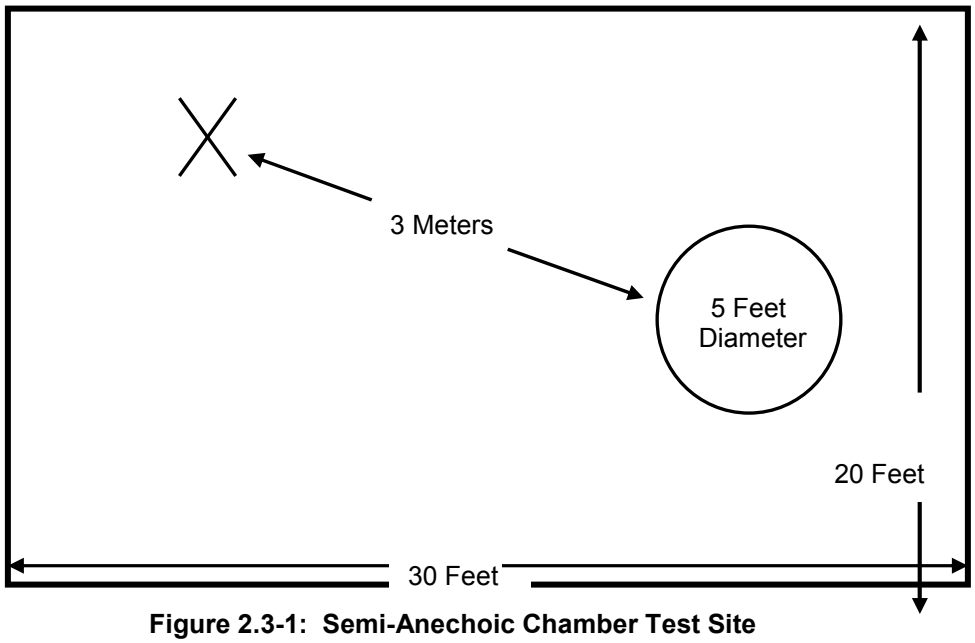

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

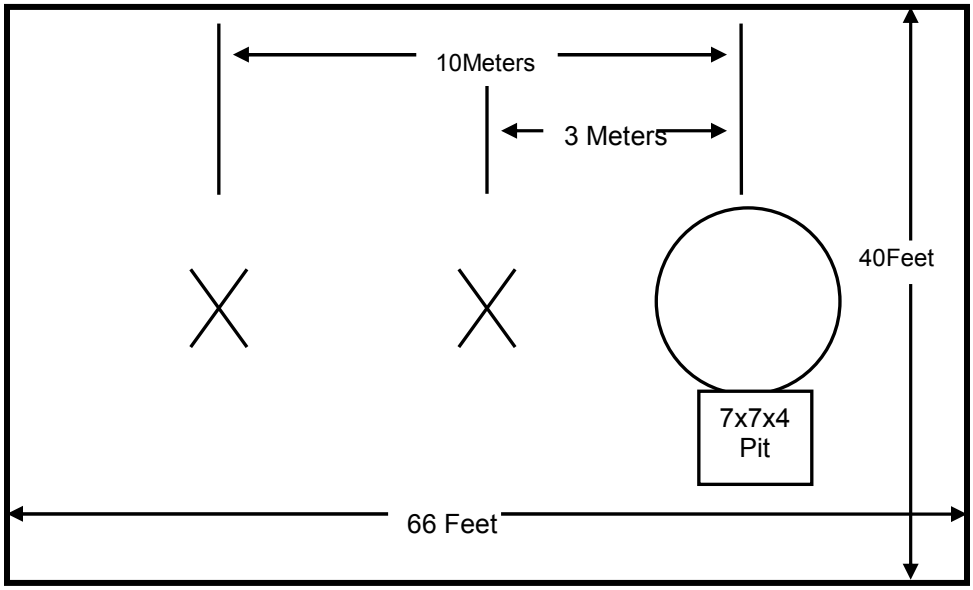

Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 8' solid aluminum horizontal ground reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 4.1.3-1:

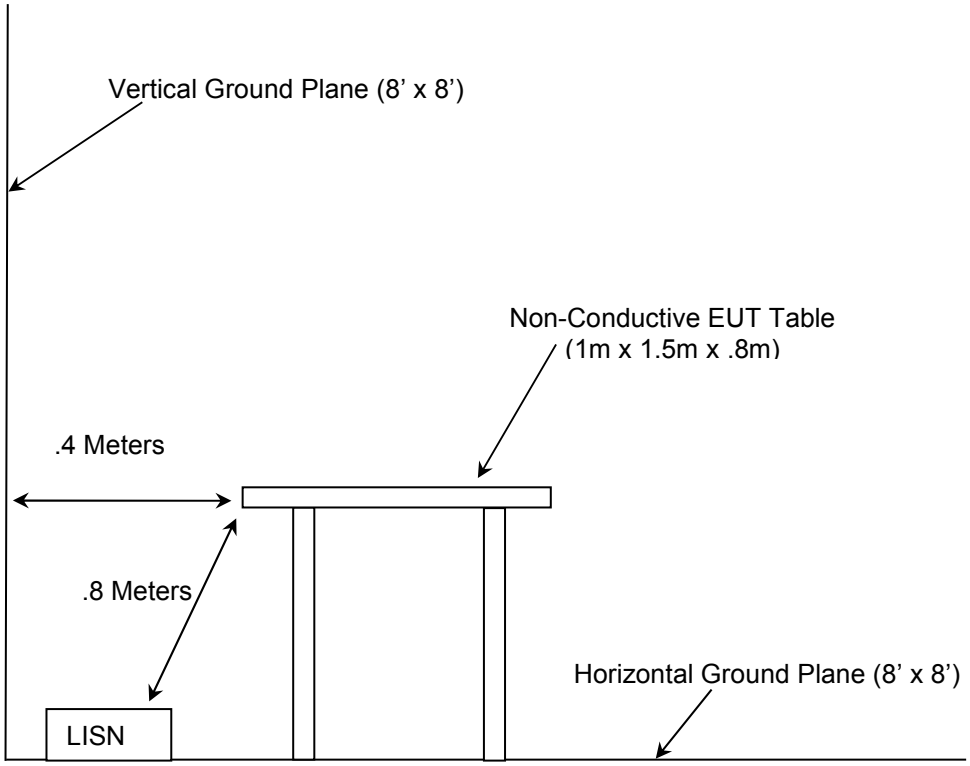

Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.10-2009: American National Standard for Testing Unlicensed Wireless Devices
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2015
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2015

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
1	Rohde & Schwarz	ESMI - Display	Spectrum Analyzers	833771/007	7/11/2014	7/11/2015
2	Rohde & Schwarz	ESMI-Receiver	Spectrum Analyzers	839587/003	7/11/2014	7/11/2015
30	Spectrum Technologies	DRH-0118	Antennas	970102	4/23/2013	4/23/2015
40	EMCO	3104	Antennas	3211	2/10/2015	2/10/2017
73	Agilent	8447D	Amplifiers	2727A05624	7/15/2014	7/15/2015
340	Aeroflex/Weinschel	AS-20	Attenuators	7136	7/14/2014	7/14/2015
167	ACS	Chamber EMI Cable Set	Cable Set	167	10/28/2014	10/28/2015
168	Hewlett Packard	11947A	Attenuators	44829	1/19/2015	1/19/2016
292	Florida RF Cables	SMR-290AW-480.0-SMR	Cables	None	3/3/2015	3/3/2016
316	Rohde Schwarz	ESH3-Z5	LISN	861189-010	10/30/2014	10/30/2015
324	ACS	Belden	Cables	8214	6/4/2014	6/4/2015
338	Hewlett Packard	8449B	Amplifiers	3008A01111	7/30/2013	7/30/2015
412	Electro Metrics	LPA-25	Antennas	1241	7/24/2014	7/24/2016
422	Florida RF	SMS-200AW-72.0-SMR	Cables	805	11/5/2014	11/5/2015
331	Microwave Circuits	H1G513G1	Filters	31417	6/2/2014	6/2/2015
616	Florida RF Cables	SMRE-200W-12.0-SMRE	Cables	N/A	9/10/2014	9/10/2015
622	Rohde & Schwarz	FSV40	Analyzers	101338	7/12/2014	7/12/2015
RE112	Rohde & Schwarz	ESIB26	Receiver	836119/012	10/30/2014	10/30/2015

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model/Part Number	Serial Number
1	Wall Wart Power Supply	Phihong	PSA20R-120	P30206373A1
2	USB Mouse	Dell	XN966	M-UAR DEL7
3	Laptop Computer	Dell	D620	CN-0TD761-12961-641-6736
4	Laptop Power Supply	Dell	HA90PE1-00	CN-OU680F-47890-91F-B2UJ-A01

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

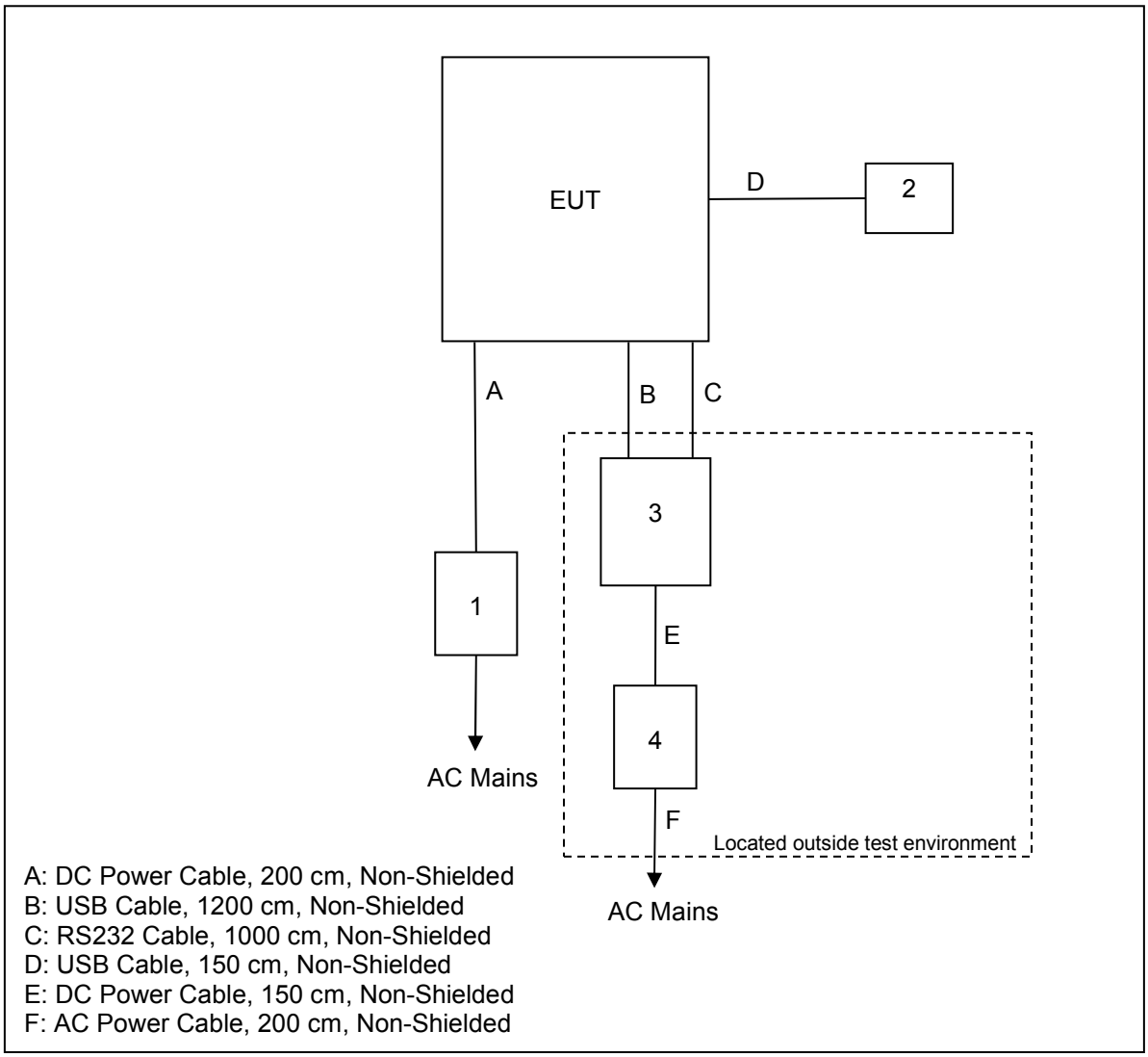

Figure 6-1: Test Setup Block Diagram

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC 15.203

The EUT utilizes an Inverted F antenna. The antenna is integral to the device and cannot be removed or replaced by the end user. The peak gain of the antenna is -12dBi.

7.2 Power Line Conducted Emissions – FCC 15.207

7.2.1 Measurement Procedure

ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Applicable Limit - Corrected Reading

7.2.2 Measurement Results

Table 7.2.2-1: Conducted EMI Results – Line 1

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
3.474449	---	36.03	46.00	9.97	L1	10.4
3.474449	44.88	---	56.00	11.12	L1	10.4
3.516132	---	36.30	46.00	9.70	L1	10.4
3.516132	45.52	---	56.00	10.48	L1	10.4
3.539980	---	36.23	46.00	9.77	L1	10.4
3.539980	45.21	---	56.00	10.79	L1	10.4
3.603507	---	35.81	46.00	10.19	L1	10.4
3.603507	45.53	---	56.00	10.47	L1	10.4
3.643988	---	34.67	46.00	11.33	L1	10.4
3.643988	44.09	---	56.00	11.91	L1	10.4
3.663627	---	34.55	46.00	11.45	L1	10.4
3.663627	44.20	---	56.00	11.80	L1	10.4

Table 7.2.2-2: Conducted EMI Results – Line 2

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
3.397495	---	35.09	46.00	10.91	N	10.4
3.397495	43.36	---	56.00	12.64	N	10.4
3.438978	---	35.05	46.00	10.95	N	10.4
3.438978	43.77	---	56.00	12.23	N	10.4
3.476854	---	36.07	46.00	9.93	N	10.4
3.476854	45.04	---	56.00	10.96	N	10.4
3.515130	---	35.95	46.00	10.05	N	10.4
3.515130	45.16	---	56.00	10.84	N	10.4
3.551202	---	35.42	46.00	10.58	N	10.4
3.551202	44.35	---	56.00	11.65	N	10.4
3.610922	---	34.81	46.00	11.19	N	10.4
3.610922	44.22	---	56.00	11.78	N	10.4

7.3 20dB Bandwidth – FCC 15.215

7.3.1 Measurement Procedure

The RBW of the spectrum analyzer was set to approximately 1 % to 5 % of the OBW. The trace was set to max hold with a peak detector active. The Delta function of the analyzer was utilized to determine the 20 dB bandwidth of the emission.

7.3.2 Measurement Results

Table 7.3.2-1: 20dB Bandwidth

Frequency (MHz)	20dB Bandwidth (kHz)
903.08	166.40
912.71	169.30

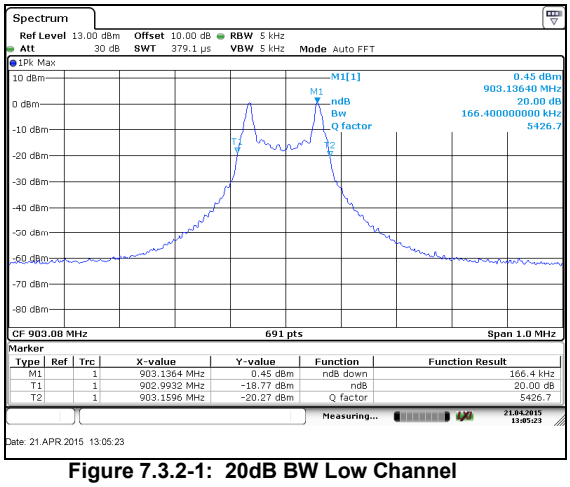

Figure 7.3.2-1: 20dB BW Low Channel

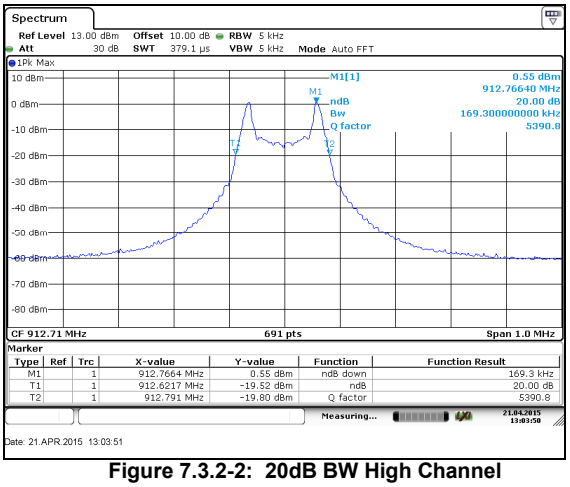

Figure 7.3.2-2: 20dB BW High Channel

7.4 Fundamental Field Strength – FCC 15.249(a)

7.4.1 Measurement Procedure

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz.

7.4.2 Measurement Results

Table 7.4.2-1: Fundamental Field Strength

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
903.08	---------	91.93	H	0.38	---------	92.31	--------	94.0	---------	1.7
903.08	---------	86.40	V	0.38	---------	86.78	--------	94.0	---------	7.2
912.71	---------	92.28	H	1.05	---------	93.33	--------	94.0	---------	0.6
912.71	---------	87.10	V	1.05	---------	88.15	--------	94.0	---------	5.8

7.5 Radiated Spurious Emissions – FCC 15.249(a)(d)(e)

7.5.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 30MHz to 10 GHz, > 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3MHz respectively.

All out of band emissions were evaluated, including any emissions at or near the band-edge.

7.5.2 Measurement Results

Table 7.5.2-1: Radiated Spurious Emissions

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
(Low Channel)										
902	---------	24.75	H	0.28	---------	25.03	--------	46.0	---------	21.0
902	---------	20.43	V	0.28	---------	20.71	--------	46.0	---------	25.3
(High Channel)										
928	---------	20.38	H	1.12	---------	21.50	--------	46.0	---------	24.5
928	---------	20.36	V	1.12	---------	21.48	--------	46.0	---------	24.5

Note: All other emissions were attenuated below the noise floor of the measurement system.

7.5.3 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation: Quasi-peak
Corrected Level: 24.75 + 0.28 = 25.03dBuV
Margin: 46dBuV – 25.03dBuV = 21.0dB

8 CONCLUSION

In the opinion of ACS, Inc. the FL6501 and FL6502, manufactured by Juniper Systems, Inc. meets the requirements of FCC Part 15 subpart C.

END REPORT